

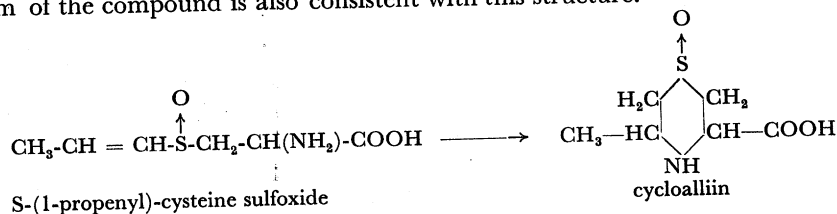
# Isolation of the Precursor of the Lachrymatory Factor in Onion (*Allium cepa*)

ARTTURI I. VIRTANEN and C.-G. SPÅRE

Laboratory of the Foundation for Chemical Research, Biochemical Institute, Helsinki, Finland

In the course of the studies in this laboratory on different constituents of onion<sup>1,2</sup> and garlic<sup>3</sup> we became interested in the lachrymatory factor in onion. Because the lachrymatory factor is rapidly formed in crushed onion, it was evident that the factor(s) is formed enzymatically from a precursor which probably is non-volatile and a more stable compound than the lachrymatory factor itself. We thus decided to try to isolate the precursor from an ethanol extract of onion.

The precursor of the lachrymatory factor was isolated in crystalline form. The isolation, which was followed by estimating the lachrymatory effect at every step of the fractionation using a crude enzyme preparation from onion, involved absorption on Amberlite IR-120, separation of the amino acid fraction on a column of cellulose phosphate (Whatman P 70) using pure water as eluant, and purification of the ninhydrin-positive fraction, which gave the lachrymatory effect after the addition of the enzyme preparation, on a cellulose powder column with butanol-acetic acid-water. The active fractions were combined, taken to dryness *in vacuo* with the exclusion of oxygen, treated with charcoal in water solution and precipitated twice with acetone. The product consisted of white crystals melting at 146—148° (decomp.) and giving an intense lachrymatory effect with our enzyme preparation. This lachrymatory precursor is relatively stable in water and 2 N acetic acid solution, but it cyclized to cycloalliin (3-methyl-1,4-thiazane-5-carboxylic acid sulfoxide)<sup>1</sup> in 2 N ammonia. The biosynthesis of cycloalliin possibly also proceeds in this way. Distillation with 4 N hydrochloric acid produces propionaldehyde which is found in the distillate, while the residue contains chiefly cysteine. On paper the lachrymatory precursor travels as alliin (S-allylcysteine sulfoxide), but alliin isolated from garlic does not give the lachrymatory effect with our enzyme preparation. The results suggest that the precursor of the lachrymatory factor is S-(1-propenyl)-cysteine sulfoxide. The IR-spectrum of the compound is also consistent with this structure.



The lachrymatory substance itself is volatile. The investigation of its structure is in progress.

Full details of these investigations will be published elsewhere.

This investigation is a part of a research project under U. S. Public Law No. 480, 83rd Congress.

## References

1. Virtanen, A. I. and Matikkala, E. J. *Suomen Kemistilehti B* **29** (1956) 134; *B* **31** (1958) 191; *B* **33** (1960) 83; *B* **34** (1961) 53; *Acta Chem. Scand.* **13** (1959) 623; 1898; *Z. physiol. Chem.* **322** (1960) 8; Matikkala, E. J. and Virtanen, A. I. *Suomen Kemistilehti B* **30** (1957) 219.
2. Virtanen, A. I. and Spåre, C.-G. *Suomen Kemistilehti B* **34** (1961) 18; Spåre, C.-G. and Virtanen, A. I. *Acta Chem. Scand.* (in press).
3. Virtanen, A. I. and Mattila, I. *Suomen Kemistilehti B* **34** (1961) 44.

Received June 6, 1961.